# The Salinity Gradient and Vegetation in the Saugatucket River Estuary



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The Saugatucket River in South Kingstown, Rhode Island, discharges freshwater into Point Judith (Salt) Pond (fig. 1), diluting the seawater along the estuary. But, one wonders, where actually does the real change in dilution occur?

The question of where the maximum effect of dilution occurs first arose during an investigation of the phytoplankton ecology of Point Judith Pond by Tomas, (1971), who noted that the phytoplankton complex seemed to consist of two parts: (a) the more marine species in Point Judith Pond below the "Narrows" (dogleg) at the southern end of Upper Pond, and (b) the more freshwater species in Upper Pond above the "Narrows." From this it seemed that the region of dilution might well be within the Upper Pond alone.

In our study to locate the region of greatest salinity change in the Saugatucket River - Point Judith Pond system, 20 stations were established at intervals between the Main Street bridge over the Saugatucket River in the town of Wakefield and the lower (western) end of the "Narrows." On November 6, 1971, samples of water were taken at low and high tide at the lower four stations (17-20). Samples were taken at low water and four hours after low water at stations 8-16 on November 11 and at stations 1-7 on November 12. The delayed sampling was done in an effort to check the water at the period of maximum dilution. In addition, the plant life which was found growing and healthy at the stations was recorded, and the vouchers were collected for later identification. The water samples were titrated for salinity, and the results were compiled (table 1) and plotted (fig. 3).

From figure 3 it can be seen that the region of extreme salinity change is in the river from just above the Silver Lake Road bridge (station 7) southward to the point where the river empties into Upper Pond (station 14). Some severe salinity extremes reach on into Upper Pond to Ram Point (station 17), and significant dilution also occurs almost to the lower end of the "Narrows." However, the greatest change is concentrated above Ram Point. This is noted both in the range in salinity and in the difference in species of plants (table 1).

Earlier Vaughan (1971), investigated the benthic algae and physical-chemical parameters of Point Judith Pond. In this work, he found high salinities in the river at U.S. Route 1 only during the drier season and considerably lower values in the spring and periods of heavy run-off. Actually, rainfall data provided by the Weather Station, College of Resource Development, University of Rhode Island (courtesy of Anthony T. Dore), showed that our study was conducted at a period of unusually low rainfall.

Thus, our findings compare well with the higher, dry-season values reported earlier by Vaughan. However, this does emphasize the vascillation in salinity that occurs at any one spot along this portion of the river from season to season based on rainfall, as well as the hour-to-hour changes based on the tides. On the other hand, the occurrence of certain species of plants in various areas (fig. 3-E) indicates that conditions in each zone have been such that the characteristic species were not eliminated. Thus, their presence is evidence that the salinity conditions in the area are sufficiently restricted to support the particular species. Perhaps, in fact, the occurrence of such species is a better overall indicator of the salinity structure at that point than are occasional samples taken and analyzed for salinity. In essence, the plant life provides a continuously operating salinity monitoring system.

In conclusion, the results of our work in Point Judith Pond show that the greatest dilution (change in salinity) is in the mouth of the Saugatucket River from a point just above the Silver Lake Road bridge to the point where the river empties into Upper Pond (station 14, just below the U.S. Route 1 bridge); and that plant life occurs in predictable zones along this estuary, the species being linked to the overall range in salinity.

TABLE 1. Benthic aquatic plants and algae of the upper region of the Saugatucket River estuary, (Point Judith Pond, Rhode Island), the stations along which they were found, location of the zones, and the salinity range at surface and 1 foot above bottom, November 6-11, 1971.

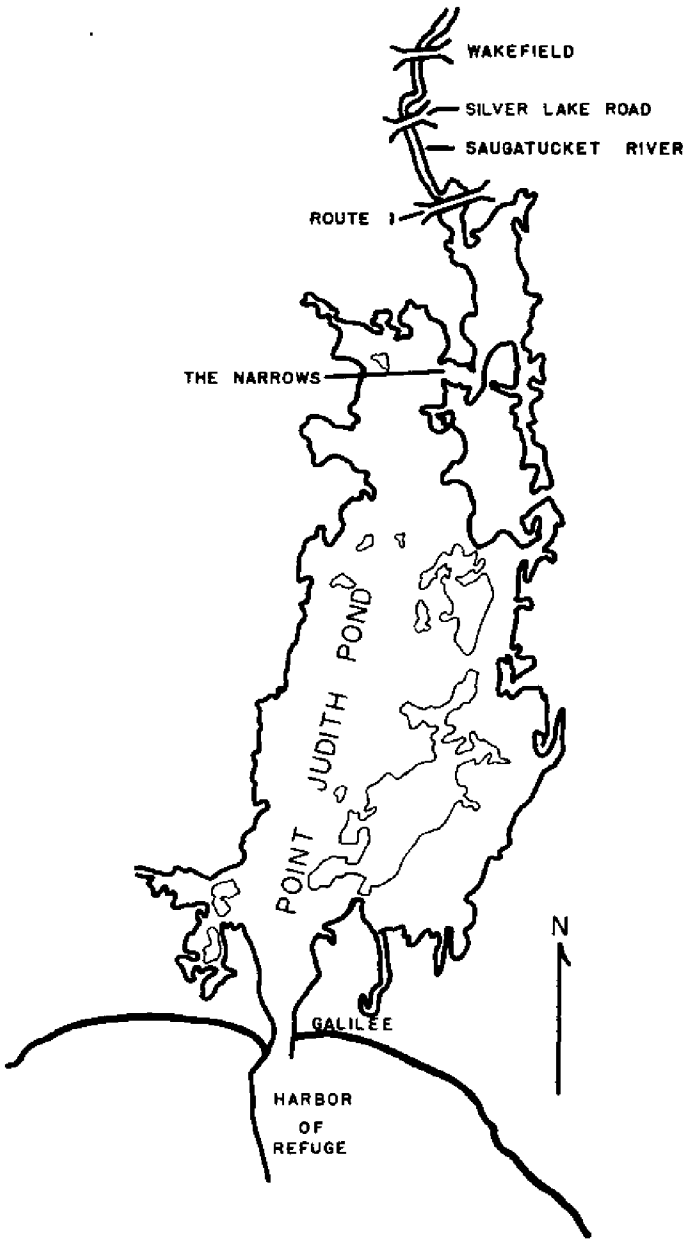
| SPECIES | STATION | LOCATION | SALINITY RANGE, o/oo minimum surface | minimum bottom | maximum at bottom |
|---|---|---|---|---|---|
| Sparganium androcladum | 1-2 | Between points 100 yd and 150 yd below bridge in Wakefield | 0.00 | 0.00 | 0.00 |
| Eleocharis acicularis | 1-2 | Between points 100 yd and 150 yd below bridge in Wakefield | 0.00 | 0.00 | 0.00 |
| Potamogeton sp. | 1-2 | Between points 100 yd and 150 yd below bridge in Wakefield | 0.00 | 0.00 | 0.00 |
| Fontinalis sp. | 1-2 | Between points 100 yd and 150 yd below bridge in Wakefield | 0.00 | 0.00 | 0.00 |
| Enteromorpha intestinalis | 6-9 | Between points 180 yd north and 120 yd south of Silver Lake Road bridge | 0.35 | 0.51 | 21.13 |
| Ulva lactuca | 11-20 | From point 250 yd north of Route 1 bridge southward throughout Upper Pond | 2.61 | 19.53 | 28.63 |
| Agardhiella tenera | 14-20 | From point 100 yd south of Route 1 bridge southward throughout Upper Pond | 7.58 | 26.83 | 28.63 |
| Codium fragile | 17-20 | From point directly east of Ram Point southward throughout Upper Pond | 17.53 | 27.53 | 28.63 |

REFERENCES

Reid, G. K. 1961. Ecology of inland waters and estuaries. Reinhold Publishing Corp., New York. 375 pp.

Tomas, Carmelo R. 1971. An ecological survey of the phytoplankton of Point Judith Pond. M.S. Thesis, University of Rhode Island. 212 pp.

Vaughan, Carleton F. 1971. An ecological survey of the macroscopic algae of Point Judith Pond (Salt Pond), Rhode Island. M.S. Thesis, University of Rhode Island. 179 pp.



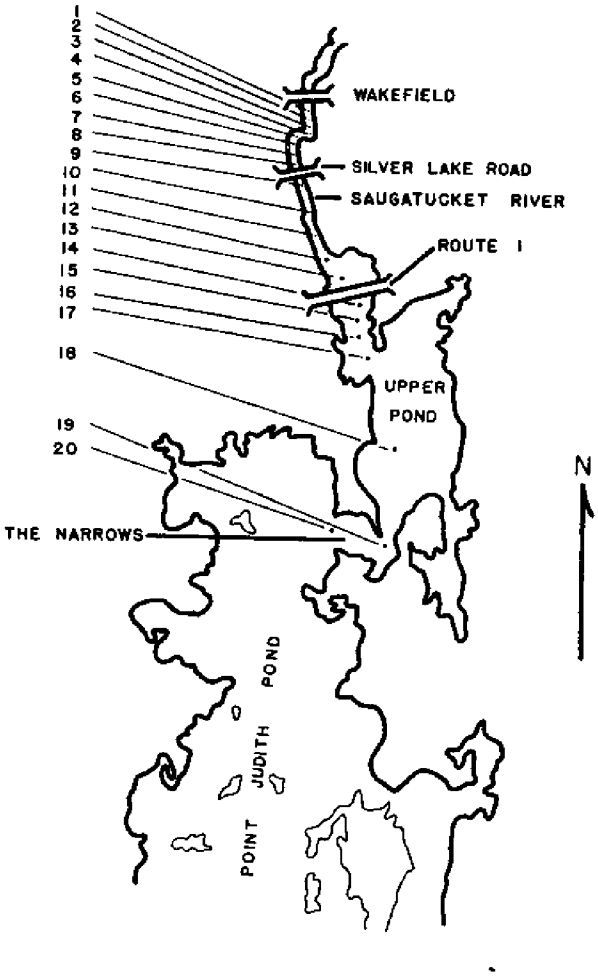
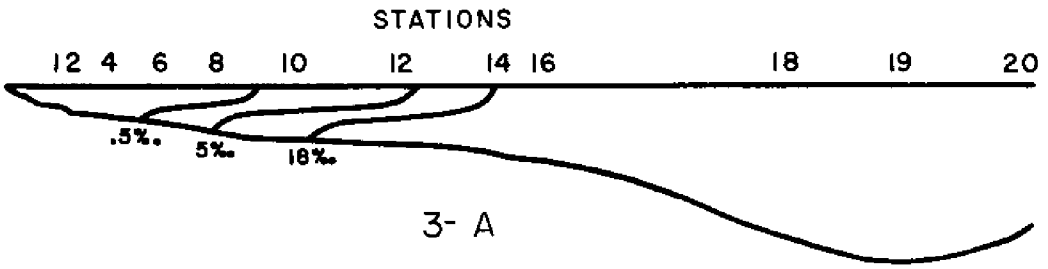




Figure 1. Point Judith Pond, Rhode Island. The Saugatucket River enters at the extreme north below the town of Wakefield, discharging into the northwest sector of Upper Pond. (Scale: 1 in = 2000 ft)

Figure 2. Locations of salinity stations in the uppermost segment of Point Judith Pond, Rhode Island, and the Saugatucket River south of the dam in the town of Wakefield. (Scale: 1 in = 1500 ft)


STATIONS
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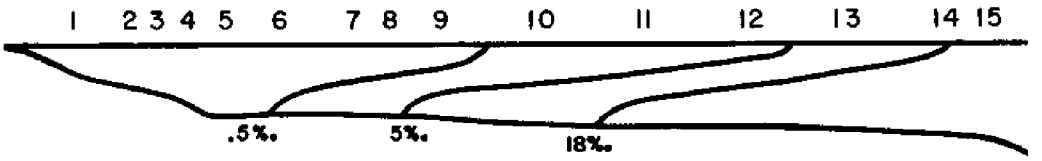
.5‰
5‰
18‰

3- A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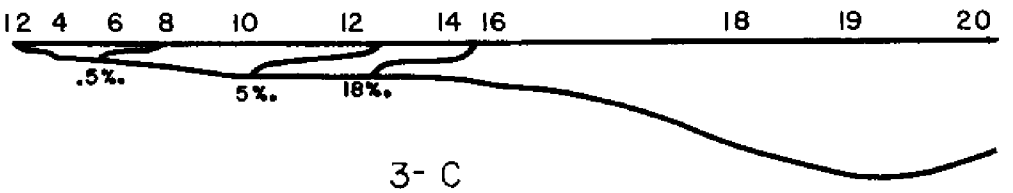
18‰

3- B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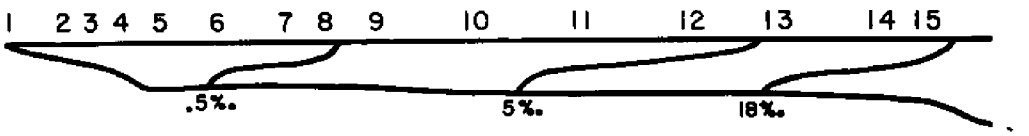
18‰

3- C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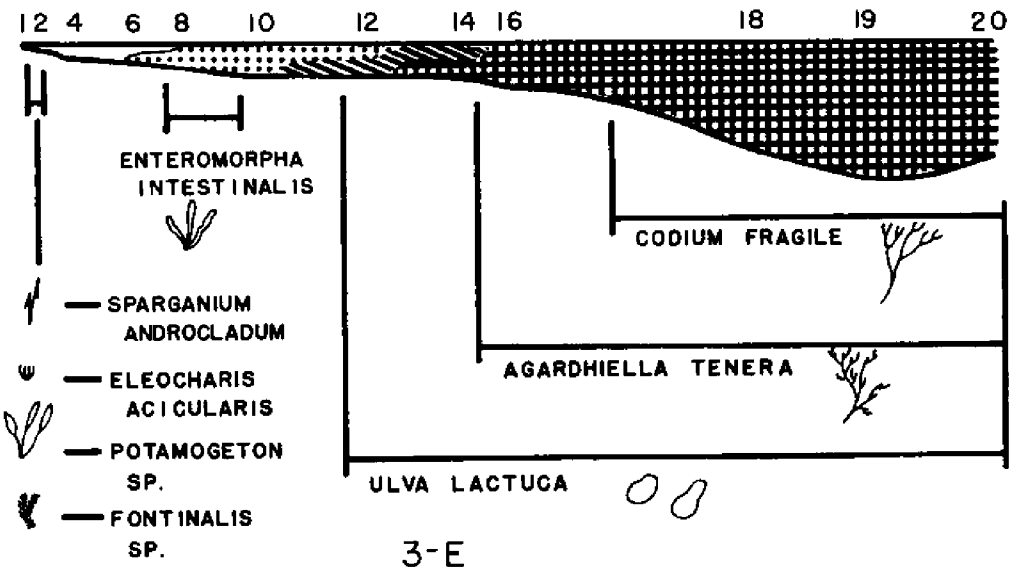
18‰

3- D


12 4 6 8 10 12 14 16 18 19 20
ENTEROMORPHA INTESTINALIS
SPARGANIUM ANDROCLADUM
ELEOCHARIS ACICULARIS
POTAMOGETON SP.
FONTINALIS SP.
CODIUM FRAGILE
AGARDHIELLA TENERA
ULVA LACTUCA

3-E

Figure 3. Center-channel profiles of the Saugatucket River and adjacent section of Upper Pond showing salinity structure and related benthic aquatic plants on November 11, 1971. The curves in profiles delineate lines of equal salinity value (isohalines). A, C, and E cover entire range of investigation; B and D cover just the upper course, showing the greatest salinity range. Scales: A, C, and E, 1 in = 1000 ft; B and D, 1 in = 500 ft; vertical exaggeration, X 125. ---A. Salinity relationships between the Wakefield dam and the lower (west) end of the "Narrows" at the south end of Upper Pond, stations 1-20 at 4 hours past low tide. ---B. Upper section of fig. A, enlarged to show details of the upper stations, 1-15. ---C. Salinity relationships between Wakefield dam and the lower end of Upper Pond, stations 1-20 at low water. ---D. Upper section of fig. C, enlarged to show details of the upper stations, 1-15. ---E. Classification of Saugatucket River estuary in zones on basis of salinity values (at low water) according to the 1958 "Venice System" (Reid, 1961:204), and the plants found in each zone:

Cross-hatched = mixo(poly)haline, 18-30 o/oo S
Diagonal-lined = mixo(meso)haline, 5-18 o/oo S
Stippled = mixo(oligo)haline, 0.5-5 o/oo S
Unmarked = limnetic, 0.0-0.5 o/oo S

The horizontal line at the sketch of each plant indicates the range of occurrence along the estuary.